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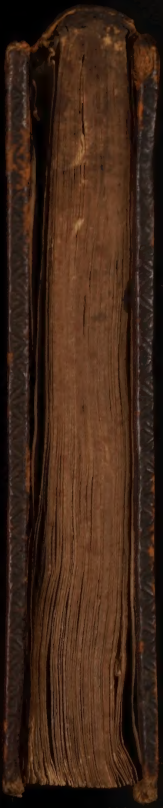

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SHORT MEMOIRS FOR THE Natural Experimental HISTORY OF Mineral Waters.

Addreſſed By way of Letter to a Friend.

By the Honourable ROBERT BOYLE, Fellow of the Royal Society.

LONDON, Printed for *Samuel Smith* at the *Prince's Arms* in St. *Pauls* Church-Yard. 168⅘.

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I Find by ſome diſcourſe I lately had with the Author, that his deſign in drawing up his Memoirs, being to ſet down what had occurr'd to him of his own Obſervation and Experiments, he purpoſely forbore to conſult the Authors that have profeſſedly written upon Medical Waters, he would by no means have it thought, that he undervalued thoſe Learned Writers that he forbore to cite, becauſe he had them not at hand, as well as becauſe his deſign did not require he ſhould tranſcribe from them. And therefore he deſires, that his Readers ſhould not be kept, by any thing he has written, from conſulting other Writers that have treated of Mineral Wa-

ters, especially the late Ingenious Exercitations, of the Learned Doctor *Lister De Fontibus Medicatis Angliæ* (after mentioned by our Author,) and the curious little Tract of the *French* Mineral Waters, that was brought our Author in *English*, after his Memoirs were come to him from the Press, publish'd by the Virtuosi of the famous Royal Academy, of Sciences at *Paris*, especially where they curiously examine the Saline and earthly Residences of Waters, which our Author has not done to the remains of our *English Acidulæ*, of which Liquors he had for the most part such incompetent quantities as concurr'd with another reason to discourag'd him from publishing his Tryals on them. Yet I may safely say what he offers here to the Reader is far beyond any thing that has been publish'd in this kind; for the Virtuosi as well as the Water-drinkers may reap no small benefit by the perusal of this learned Treatise, as containing a great number both of useful Observations, and unusual Experiments.

Adver-

Advertisement.

THE Author of the following Papers had thoughts of reviewing and inlarging them before he parted with them; and at least, of annexing Notes to several of those Titles of the historical Platform, that are yet left untouch'd. But, besides his want of health and leisure, he was, by the supervening of some urgent occasions, oblig'd abruptly enough to lay aside this work he was about, and apply himself to others, that concern'd him more than the Scrutiny of Mineral Waters could. Wherefore considering, that he had already made Annotations, though but short ones, upon most of the considerablest Titles or Topicks of inquiry, enumerated in the Second and Principal Part of his

Schemes above them, he was content to give the enſuing writing unfiniſhed as it was, to the Solicitations of ſome Vertuoſi, *who rather than tarry till he ſhould have an opportunity, which he knows not how long he ſhall want, were deſirous to take what they found ready, with all its imperfections. Which preſſingneſs of theirs he could not deny to be the more excuſable, on this occaſion, becauſe the communicated writing is not pretended to be a full and methodical Hiſtory of Mineral Waters, but only a bundle of* Short Memoirs, *contributed towards the compiling of ſuch a Work.*

Theſe, that they may be the more conveniently cited or referr'd to, I thought fit to divide into ſix Sections; whereof the Firſt is introductory, and and contains ſome General Conſiderations about the Occaſion, the Subject, and ſome other things relating to thoſe Memoirs. The Second contains only a ſet of Titles for the Firſt Part of the propoſed Work, becauſe urgent occaſions kept me from making, as I intended,

intended, some Marginal Notes, upon several of the particular Articles. The third exhibits a Scheme of Titles for the Second Part of the propos'd work, viz. *The way of experimentally exploring portions of a Mineral Water sever'd from the Spring or Receptacle. And because the Second Part is that which I mainly design'd, I have referr'd to it two other Sections,* one, *which is the Fourth, containing a Collection of Experiments and Observations relating to the usual way of examining Mineral Waters by Galls, as a* Specimen *given on the 13th Title of larger Annotations on the Titles of the Second Part; and the* other *consisting of less copious Annotations, and sometimes much shorter Notes on divers other Articles of the same Second Part. To which lastly is subjoyn'd the sixth Section, consisting only of a Set of Articles, referrable to the Medicinal use of Mineral Waters; together with a Conclusion address'd to the ingenious Dr. that set me upon this Task. In prosecuting of which I desire*

it may not be thought strange, that I have not cited Authors that have written of Thermæ *or of* Acidulæ. *For in the disadvantageous Circumstances wherein I wrote, I should have been kept from consulting them, if I had had them at hand. And I thought it enough for for me at that time, to impart to my Friends, what my own Experiments and Thoughts had furnish'd me with, how little or mean soever that was. Which Advertisement is therefore the more fit to be here given, that I may not divert any from studying those more elaborate Pieces, that have within no long time been publish'd by skilful Men, and especially by the very learned,* Dr. Lister.

The

The most Material Heads contained in the foregoing Treatise.

1. *THE Advertisement to the Reader, containing the Division, Method and Scope of this present Treatise.*
2. *The occasion of this Treatise, and its importance.* page 1, 2
3. *That the best way of discovering the Qualities of Mineral Waters, is a long and sufficient Experience.* 3
4. *What may encourage us to undertake the Natural History of Mineral Waters?* 4
5. *What things are fit to be taken notice of by him that would give an historical account of Mineral Waters.* 5, 6
6. *That the Author hath both qualified Practical and Speculative Physicians by this Treatise.* 7

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7. *What hindred the Author from illustrating all the sets of Titles with a kind of* Rationale. 8

8. *Wherefore the Author hath proposed so many different inquiries about Mineral Waters.* 9, 10, 11, 12

9. *Upon what account the Examin of the properties of Mineral Waters is of so great importance.* 13, 14

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11. *Titles for the Natural History of a Mineral Water proposed considered as being gilt in its Channel or Receptacles, being the first or Mineralogical part of the designed Work.* 17

12. *Titles for the Natural History of a Mineral Water proposed consider'd as drawn out of the Spring or Receptacle, being the Second or Physico Chymical part of the designed work.* 24

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Reformed Church at *Paris*: Translated from the French Original, in *Twelves*, 1683.

Protestancy to be Embraced; or a new and infallible Method to reduce Romanists from Popery to Protestancy. 1683. *pr.* 1. *s.*

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FINIS.

Short Memoirs

FOR THE

Natural and Experimental

HISTORY

OF

Particular Mineral Waters,

Addreſs'd to his Learned Friend, Dr. *S. L.*

SECT. I.

SO many years, Sir, have paſt, ſince I had occaſion to conſider Mineral Waters, and opportunity to make Tryals on them with any Application of Mind;

that, *tho'* ſince that time ſome *Virtuoſi* have been pleas'd publickly to declare, that they found ſome directions they received from me not unuſeful to the *Examen* of ſuch Waters ; *yet* having forgotten many of my paſt thoughts, and loſt or miſlaid moſt of my Memorials about matters of fact relating to thoſe Liquors, I fear I ſhall not be able to ſatisfy either you, or my ſelf, by what I now write about them. But however, *ſince* you will needs have me ſay ſomething upon this Subject ; *ſince* it is a noble one, as that wherein the health of thouſands is concern'd ; *ſince* 'tis of late grown to be more priz'd and diſcours'd of, than ever ; and *ſince* I have obſerved mens curioſity about it to have been confin'd to very narrow Limits, moſt men contenting themſelves with the diſcoveries they can make by the Infuſion of Galls (or their Body,) and perhaps a ſlightly improv'd evaporation : *Since*, I ſay, I have theſe invitations to obey you, I am content

to

to offer you my Advices, such as they are, for the drawing up of such a natural History of a Mineral Water propos'd as, being comprehensive of many Inquiries and Wayes of Indagation that even Physicians have either not known or overlook'd, may probably afford a more reaching notice, and inlarg'd knowledge of the Subject treated of. Upon which account I have, I confess, a desire and an aim, tho' no great hope, that this rude Essay may, by your Improvements and those of your Learned Friends, be made of some service to the Publick.

2. But here I must ingenuously own to you, that notwithstanding the many wayes I propose, of discovering the natures or Qualities of Mineral Waters, yet I think the surest way of knowing them, is a long and sufficient Experience of their good and bad effects. For I strongly suspect, and it may be partly know, that there are, beneath the surface of the Earth, divers Mineral Substances,

some fix'd, and *some* volatile, *some* in the form of hard Bodies, *some* of soft ones, *some* of Liquors, and *some* of Fumes, divers of which the generality, even of Learned men, are altogether strangers to; besides those that, tho' some men may chance to have seen, have their natures so little known, that they have not so much as names assign'd to them. So that when I consider, that of the Ingredients we are unacquainted with (to pass by all the rest that the Earth may conceal) the proportions wherein they are mingled may be numberless, and the Qualities resulting from these Commixtures may be very differing from those of the separate Ingredients, I am apt too look upon the difficulty, of *Securely* determining the Effects of Mineral Waters *à priori*, as little, if at all, less than insuperable to Humane Understandings.

3. But this difficulty is not such, as ought to make us think it useless, to have a good Project of the natural

ral Hiſtory of a Mineral Water. For 'tis no ſmall advantage, to know what particulars are fit for our Inquiry, to be furniſh'd with a Sett of heads, to which one may conveniently refer whatever he tries, or obſerves, about the Subject propos'd. And (which is yet more conſiderable) *to* be furniſh'd with variety of Methods or ways, to make Tryals fit for inveſtigating the Nature, or examining the Qualities, of the propos'd Water; ſince by the number and variety of purpoſely and fitly devis'd Experiments, he that makes them may, as it were, view his ſubject on all ſides, and be much aſſiſted to conjecture, what Saline, or other Minerals known to us, and what quantities of them, do impregnate the Water he examines, and conſequently what effects they are like to produce in Humane Bodies.

4. Though there be three ſorts of things, fit to be taken notice of by him that would give an Hiſtorical account of a Mineral Water, whether

cold or hot, yet contenting my self to treat but very curſorily of thoſe that belong to the firſt, and to the third of the three ſorts, I have made a more full and particular Enumeration of the Titles that peculiarly belong to the ſecond ſort of obſervables, namely thoſe that mention the various Tryals, Chymical and Mechanical, that are to be made with the Water after 'tis taken out of the Spring. This I purpoſely did, chiefly becauſe 'twas only of this ſort of particulars that you deſir'd my thoughts, and partly alſo becauſe they are moſt wanted and deſir'd by Naturaliſts and Phyſicians, and are like to prove the moſt inſtructive to them; having alſo this to recommend them, that, to make the greateſt part of them by far, it is not neceſſary that a man repair to the place where the Spring riſes, but he may at leiſure examine the Water at home, where he may be accommodated with Furnaces, veſſels, and other conveniences, to make his Tryals upon it.

5. A

5. A much leſs diſcerning Reader, than you, may perceive that in forming the inſuing Project of a Natural Hiſtory, I aim'd much more to aſſiſt practical Phyſicians to find the vertues and effects of Mineral Waters, than to inform Speculative Naturaliſts of their cauſes and manner of being generated. But yet a heedful peruſer may find, that I have ſo endeavour'd to gratify Phyſicians, that I have not been altogether wanting [eſpecially in the Firſt Part, which is almoſt wholly Mineralogical,] to the curioſity of Philoſophers, as it relates to all ſorts of Mineral Waters: Tho' you may eaſily enough diſcern, and readily confeſs it, that the following Paper does much more regard thoſe cold ones, that from the Acid Taſt that is found in moſt of them are call'd *Acidulæ*, than thoſe other Waters, that from their heat are commonly ſtyl'd *Thermæ*, becauſe the former ſort of Mineral Waters is that, which I have had the opportunity to be the more converſant in, as well as

that, about which alone you have desir'd my Observations.

6. I had once thoughts of illustrating the following Setts of Titles with a kind of *Rationale*, briefly declaring the reason of their order and their number (for both these were considerately pitch'd upon, not lighted on by chance.) But I was obliged to omit it, when I found (as I quickly did) that I had too little leisure and health, to imploy much of either upon a troublesom work of no greater importance. And therefore, knowing your Perspicacity to be more than sufficient to make you discern some reason for the order wherein I have marshall'd the Articles of the *last* Sett of Titles which fall under the Cognizance of your own Profession, I have not been solicitous to assign that Reason. And I presume 'twill be no great harm, if my hast have made me also omit to perform at present the Intention I had to make here and there some Brief Marginal Notes upon some of the Articles of the first Part. And

I thought it ſufficient (if not alſo capable of making ſome amends for the newly mentioned Omiſſions) to make them ſomewhat numerous, and ſome of them large Annotations upon the Titles or Articles of the II Part: This being indeed the chief that I deſign'd to inſiſt on, and preſent you.

7. I expect it will be wonder'd at, that ſo many Inquiries ſhould be propos'd, and ſo many things directed to be taken notice of, about a Subject that hath been thought ſo barren, that men are wont to think their curioſity great enough, if they inquire what colours the Mineral Water will ſtrike with Galls, or Oaken leaves; and do obſerve what kind and quantity of Salt will remain after the evaporation of the Liquor : And I much fear, that ſome, even of your profeſſion, will think I cut them out a great deal too much work, by ſo many troubleſome Queries and Tryals. But I confeſs that nature or long experience having made me, tho' not a Sceptical, yet a ſuſpicious and diffident

fident Philosophiser, I think my self obliged, on difficult occasions, to ask more than ten Questions before I presume to answer one. Nor do I think that the slightness of anothers curiosity dispenses me from industriously exercising mine. I might on this occasion represent, that tho' the greatest Naturalists, and Physicians among the Ancients, did not only mention, but admire and discourse of the Loadstone; yet our *Gilbert* thought fit to examine it further, and was thereby able to discover far more numerous *Phænomena*, than all them put together had taken notice of. And I might add other instances to the same purpose; but to answer more closely, and directly, I say, that, to discover the nature of Mineral Waters, being a thing far more difficult than those, that have not try'd, do imagine, I think we ought to view the Subject in as many differing lights as we can expose it to, and take in as many helps to discovery as we can; since a great many particulars, that singly, or at

the first view, seem not very pertinent, if they be survey'd in conjunction, and be skilfully apply'd, may much conduce to the desir'd end. And perhaps hereafter it will be found useful, if not necessary, to make large additions to the Topicks, whose number is now thought redundant: For the more qualities and other particulars, we are acquainted with in any Subject, the better grounded, and the more enlarged knowledge we have of it. As for the trouble it may cost, to make the proposed Enquiries and Tryals, it may be said, 1. That they are not all necessary (though useful) nor yet of equal moment, and therefore the omission of some, that are less important, may not disappoint the main Searches. 2. I have purposely made most of the Tryals as easy and short, as the matter and Scope will permit; and those, that will not undergo some trouble in seeking an useful truth, do not deserve to find it, especially since, in the chase of noble discoveries

veries, as in hunting the nobler game, the toyl oftentimes makes a part of the pleasure. And I have made the less scruple, to be somewhat ample in the enquiries I propound, because divers observations have perswaded me, that Physicians ought to consider very well both the nature of the Waters they ordain, and to what persons, for what Diseases, and in what manner, they prescribe the use of them: For tho' many look upon them as such innocent Medicines, as, if they do no good, can at least do no harm, yet the effects, that have too often insu'd the unskilful use of them, especially when it was long continued, allow me not to look upon the drinking of Mineral Waters as a slight thing, that may safely be plaid with, but as that whereby we have seen, as very much good, so a great deal of mischief, done, especially some time after the operation is thought to be quite over, and perhaps almost forgotten.

8. I look upon the examen of the Properties

Properties, and other Qualities, of Mineral Waters, as a thing that is therefore of the greater importance, becauſe I am apt to think, upon probable grounds that, by a diligent inquiry, there may be diſcover'd in *England* (and in divers other Countries too) a far greater number than is yet imagin'd of Mineral Waters, eſpecially Ferruginous ones; which I therefore gueſs will be found very numerous, becauſe, by ſome uncommon wayes of Tryal that I have imploy'd, I have found that divers Minerals that either men knew not what to make of, or by reaſon of their paſſing under other names did not ſuſpect to be Martial, did yet partake of, and perhaps abound with, parts of a Martial Nature. And I ſhew in another Paper [*about the Magnetiſm of the Earth*] that kindly provident Nature, or rather its Divine Author has, under various diſguiſes, furniſh'd our Globe with a far greater plenty and variety of Iron Ores and Minerals, that partake of that Metal, the moſt uſeful by far

to

to mankind, than of any other Metal. And as Martial Minerals do thus abound in the Earth, so they are more dispos'd, than one would suspect such hard Bodies could be, to impregnate even such Liquors as are not manifestly acid, and seem unlikely to be able to work upon Minerals far less hard than they. To make this probable, we took not *Iron Ore*, or *Embryonated Mars*, but pure Steel it self, the same as Needles were made of; and upon the minute Filings of it, we put some Tincture of Galls made with common Water, and filtred through Cap-paper, that the present colour of the Liquor, and the change we expected to be made in it, might the better appear: And by this Tryal we found that, in less than an hour, the transparent infusion of Galls was so alter'd, as to be grown not only opacous, but of a dark and almost inky colour, which it retain'd even after Filtration; and this tho' the Vial, that contain'd it, was very slender. A not unlike effect was produc'd by small

Filings

Filings of steel, but somewhat slower in the red Tincture of Brazil, and in that of Logwood, made with common Water.

9. I know not whether it may not be fit to be represented, on this occasion, that, in Countries manifestly abounding with Metalline and other Minerals, it may perhaps be worth while, that mens Curiosity descend much lower than the *superficies* or Turf of the ground, and make search both after Subterraneal Springs, and Wells, and their operations upon Humane Bodies. For I have upon Inquiry been assur'd, by those that in several places have visited Mines, that they have met with in them, and sometimes at very great Depths, running, as well as Stagnant, Waters, of differing Tasts, and sometimes other Qualitie; and that the Diggers, venturing to make use of them to quench their Thirst, *as* they found some of them mischievous (as Corrosive, Petrific,) *&c.* so they met with others that were not only innocently

Potable,

Potable, but Medicinal. Of both these sorts we have Instances in our Tin-Mines of *Cornwal* in *Devonshire*. And of the latter sort I receiv'd from an ingenious Gentleman, that has the oversight of some *Cornish* Water-works, this memorable Answer to an Inquiry I sent him. The strangest Account, saies he, of Mineral Waters that I have yet had, was of that in the bottom of a Tin-work call'd *Karnkey*, wrought above 60 fathom [that is 360 foot deep;] the Mineral being a mixture of Tin and Iron, and the Water Red and Puddle, yet drunk was cool and not nauseous, and would pass by Urine, near as Red as it was drunk, as I have been inform'd by those that drunk of it whilst it [the Mine] was working, being now struck out, [that is, the vein of Ore being degenerated, or lost.] However I believe Experiments might yet be made with Water much of the same nature. Thus far he, from whom, notwithstanding the remoteness of the place he lives in, I hope to get some

ſome of this Liquor, to make Tryal of; which if I do, I deſign you an account of the Effects.

I could enlarge upon the Subjects of theſe two laſt (the 8th and the 9th) Numbers. But after ſo long an Introduction to ſhort Memoirs, 'tis high time that I come at length to ſet down the Topicks themſelves that I deſign to propoſe.

SECT. II.

TITLES

For the Natural Hiſtory of a Mineral Water propos'd, conſider'd as being yet in its Channel or Receptacles: (*Being the firſt or mineralogical part of the deſigned work.*)

HE that would draw up the Hiſtory of a Mineral Water, [to have its qualities ſome examin'd and ſome inveſtigated,] ſhould, in my opinion, make three ſorts of obſervations about it. For firſt he ought

to take notice of those particulars that relate to it whilst 'tis yet under ground, or in its native receptacles: Next he is to examine the properties and other qualities of it, when 'tis drawn up by men at the Springhead, or other receptacle: Lastly he is to consider the operations and effects of it upon Humane Bodies, whether sick or sound, according to the several ways and circumstances made use of in administring it.

To the first of these three sorts of observations may be referr'd such heads or titles as these.

1. In what climate and parallel, or in what degree of Latitude, the Mineral Water do's spring up, or stagnate?

2. Whether the Spring-head, or other receptacle, do chiefly regard the East, the West, the North, or the South?

3. Whether the Water be found in a Plain or Valley? And if not whether it arise in a Hillock, a Hill, or a Mountain?

4. And

4. And whether it be found at or near the top, the middle, or the bottom, of the rising ground.

5. Whether the waters leave any recrement, or other unusual substance, upon the Stones, or other Bodies that lie in the Channels they pass through as they glide along, or the Receptacles that contain them?

6. Whether there be beneath or near the Medicinal Water, any subterraneal fire, that hath manifest chimney's or vents and visibly (by night only, or also by day,) burns or smoaks, either constantly, or at certain periods of time?

7. Whether at or near the mouth, or orifice, of the abovementioned chimneys or vents, there be found either flowers of Brimstone, or a Salt like Sal-Armoniac, or some other Mineral Exhalations in a dry Form?

8. Whether there be under or near the course or channel of the Water, any subterraneal Æstuary, or latent mass, of hot, but not actually, or at least visibly, burning matters? And

whether ſuch Æſtuary afford an uniform heat as to ſenſe, or have periodical hot fits, as it were; and if ſo, whether theſe come at certain and ſtated times, or uncertainly or irregularly?

9. Whether it be obſerved that over the Æſtuary, or in ſome other neighbouring part of the place, where the Mineral Water ſprings, there ariſe any viſible Mineral fumes or ſmoak, (which when they do appear are wont to do it early in the Morning, or late in the evening,) and if ſuch fumes aſcend, how plentiful they are, of what colour and of what ſmell?

10. What is the more obvious nature of the not manifeſtly Metalline, nor Marcaſitical part of the Soil, which the Medicinal Water paſſes through or touches? And what are the Qualities of the neighbouring Soil, and the adjacent Country? As whether it be rocky, ſtony, clayiſh, ſandy, chalky, &c.

11. Whether there be any Ores, marcaſites, or Earths, (eſpecially highly colour'd ones) impregnated with Mineral

Mineral Juices, to be met with in the courſe of the medicinal Spring, or in the receptacle of the ſame water ſtagnant? And what theſe Minerals are, whether copperiſh, ferrugineous, Marcaſitical, &c. And whether the Ores do, or do not, abound in the Metalline portion? As alſo with what other Ingredient as ſpar, cauke, Sulphur, Orpiment, Arſenick, &c. (Whether Innocent or hurtful) they are mingled, or elſe compacted together?

12. Whether it can be diſcover'd, that the Spring of the Medicinal Water was common Water before it came to ſuch a place, or part of the ſoil it runs through, & there begins to be manifeſtly impregnated with Mineral Bodies?

13. And whether in this caſe, it makes any effervescence, or other conflict, with the Mineral it imbibes, or with any other Water or Liquor that it meets with in its way; and whether the conflict produce any manifeſt heat or no?

14. Whether, if the Mineral Wa-

ter propos'd be manifestly hot, or extraordinarily cold; the Springs it flows out at, or the Receptacle it stagnates in, have near it (and if it have how near) a Spring, or well of Water, of a contrary quality, as 'tis observ'd in very neighbouring Springs in some few places of *France*, and elsewhere?

15. Whether, when the Water appears in the Spring or Receptacle, there appear also, either floting at the Top, or lying at the bottom, or swimming between both, any drops or greater quantity of Oyl, (like *Naphta* or *Petroleum*,) or some other bituminous & inflammable substance.

16. Whether the Water be considerably altered in quantity or quality, by the different seasons of the year, as Summer, Winter, &c. By the much varying Temperatures of the Air, as to heat, coldness, drought, &c. By the plenty, or paucity, frequency, or unfrequency, of falling Rains, or Snows: And what may be the bounds, and measures of these alterations of the Mineral Water?

17. Whe-

17. Whether any thing considerable can be certainly discover'd, or any very probable conjecture made of the nature and qualities of the substances, that impregnate the Water, *by* Chymically and Mechanically examining the Mineral Earths, through which it flows, or in which it Stagnates? And particularly, by observing their colour, whether native, or acquir'd by being kept in the fire; their specifick gravity; their affording, or not affording, any Salt, or other soluble substance, by decoction; their being soluble, or indissoluble, in particular Chymical *Menstruums* of several sorts, as *Aqua fortis*, Spirit of Salt, *&c.* And their being committed to destillation in Vessels of differing sorts, and various degrees of fire, with care to receive separately the differing substances they afford, whether in the form of Liquors, or of Flowers; and by examining these substances by fit and proper wayes as also the *Cap. Mort.* by calcination, elixiviation,

and (if it will bear such a fire) vitrification?

SECT. III.

TITLES

For the Natural History of a Mineral Water propos'd, consider'd as being drawn out of its Spring or Receptacle: (Being the II. or Physico-Chymical part of the designed work.)

THat this Scheme of Titles may be the better understood, and the more instructive and useful, tho' I have not time to write an ample comment upon it all, yet I thought fit to illustrate most of its Particular Articles by such Notes, as may either explicate the meaning of what is but briefly couch'd, or deliver some of the practical ways of Tryal, that I make use of, on occasion

sion of the Subject mention'd in the Title or Article, whereto the Notes belong. These being divers of them too large to be conveniently plac'd the Margin, are all of them set down together after this Sett of Titles.

TITLE.

1. Of the actual coldness or heat of the Mineral Water propos'd.
2. Of the specific Gravity of the Mineral Water propos'd.
3. Of the Transparency, the Muddiness, or the Opacity of the Mineral Water.
4. Whether the Mineral Water will, by standing for a competent time, let fall of it self any *Oker*, or other earthy substance, especially tho' the Liquor be kept from the Air.
5. Whether any thing, and if any thing, what can be discover'd in the Mineral Water by the help of the best Microscopes adapted to view Liquors ?

6. Of

6. Of the colour or colournes of the Mineral Water.
7. Of the odour of the Mineral Water, as Acetous, Winy, Sulphureous. Bituminous, &c.
8. Of the taſt of the Mineral Water, as Acid, Ferruginous, Vitriolate, Lixivial, Sulphureous, &c.
9. Whether any change will be produc'd in the tranſparency, colour, odour, or taſt of the Mineral Water, by its being taken up at the Spring-head or other Receptacle, or remov'd to ſome diſtance, by its being kept ſtop'd or unſtop'd for a greater or leſſer ſpace of time; and by its being much warm'd or refrigerated, and alſo, by naturally or artificially, produc'd cold, turn'd into Ice, and thaw'd again?
10. Of the thinneſs or viſcoſity of the Mineral Water.
11. Whether the Mineral Water be more eaſy to be heated and cool'd, and to be dilated and condens'd

condens'd than common Water?

12. Whether the Mineral Water will of it self putrify, and if it will, whether sooner or later than common Water, and with what kind or degree of stink and other *Phænomena*?

13. Of the change of colours producible in the Mineral Water by astringent Drugs, as Galls, Pomgranate-peels, Balaustium, red Roses, Myrobolans, Oaken Leaves, *&c.* as also by some Liquors or Juices of the Body.

14. Whether any thing will be precipitated out of the Mineral Waters by Salts or Saline Liquors, whether they be Acid, as Spirit of Salt, of Niter, *Aqua Fortis*, &c. Or volatile Alcali's, as strong Spirit of Urine, Sal-armoniac, *&c.* Or Lixiviate Salts, as Oyl of Tartar *per deliquium*, fixt Niter, *&c.*

15. How to examine with evaporation, whether the Mineral Water contain common Salt, and if it do, whether

whether it contains but little or much?

16. How to examine, without evaporation, whether the Mineral Water have any acidity, tho' it be but very little.

17. Of the Liquor or Liquors afforded by the Mineral Water by Destillation *in Balneo*, and other wayes.

18. Of the residence, *Cap. Mort.* of the Mineral Water, when the Liquor is totally evaporated or distill'd off; and whether the *Cap. Mort.* be the same in quantity and quality, if produc'd by either of those wayes?

19. Whether the propos'd Water, being in Glass Vessels exactly luted together slowly and warily abstracted to a thickish substance; This being reconjoin'd to the distill'd Liquor, the Mineral Water will be redintegrated, and have again the same Texture and Qualities it had at first?

20. Whether a Glass-full of the Mineral

neral Water, being Hermetically seal'd and boil'd in common Water, deep enough to keep it always cover'd, will have its Texture so alter'd as to suffer an observable change in any of its manifest Qualities? And if it do, in what Qualities, and to what degree of alteration?

21. Of the proportion of the dry *Cap. Mort.* to the Mineral Water that affords it.

22. Of the division of the *Cap. Mort.* into saline and terrestrial and other parts not dissoluble in Water, in case it contain both or more sorts.

23. Of the proportion of the Saline part of the *Cap. Mort.* to the Terrestrial.

24. Of the fixity or volatility of the Saline part in strong fires.

25. Whether the Saline part will shoot into Crystals or no? and if it will, what figure the grains will be of? and if it will not whether, being combin'd with a Salt that will

(as

(as purify'd Sea-Salt Peter &c.) it will then chrystallize; and if it do, into what figures it will shoot, especially if any of them be reducible to those of any *species* of Salt known to us?

26. To examine whether the Saline part be, *ex prædominio*, acid, alcalizate, or adiaphorous?

27. Of the observables in the Terestrial portion of the *Cap. Mort.* as besides its quantity in reference to the Saline, its colour, odour, volatility or fixity in a strong fire; its being soluble, or not dissoluble by divers *Menstruum*'s, as Spirit of Vinegar, Spirit of Urine, Oyl of Tartar, &c.

28. Whether, and (if any thing) how much the mineral waters Earth looses by strong and lasting Ignition? What changes of colour, &c. it thereby receives? whether it be capable of Vitrification *per se*? and what colour, (if any,) it will impart to fine and well powder'd Venice glass if they be exactly mix'd,

and

and flux'd into a Transparent Glass?

29. Of the Oeconomical, and Mechanical uses of the Mineral Water, as in Brewing, Baking, Washing of Linnen, Tanning of Leather, or Dying of Cloth, Callico's, Silks, &c, as these may assist in discovering the Ingredients and Qualities of the Liquor propos'd.

30. Of the imitation of Natural Medicinal Waters, by Chymical and other artificial wayes, as that may help the Physician to guess at the quality and quantity of the Ingredients that impregnate the Natural Water propos'd.

AN

An Appendix

Containing

1. *Paralipomena*, or things directly belonging to the History and pretermitted in it.

2. A *Chaos* of Observations and Experiments, remotely or indirectly referable either to one or more of the foregoing Titles, or to the common Subject of them all.

SECT.

SECT. IV.

Experimental Remarks upon the (usual) way of examining Mineral Waters, by the help of Galls: Deliver'd by way of Larger Annotations upon the XIII. *Article of the* II. *Part.*

SInce the change of colour that Mineral Waters produce in the Infusion or Tincture of Galls, is the most usual way that many Physicians, and the almost only that some of them, endeavour to discover or examine Mineral Waters by; it may be worth while, in this place, to set down some remarks, that I have made about this way of probation; & the rather because it may, *mutatis mutandis*, be not unusefully apply'd to the exploring the Quality's of Mineral Waters by Colorations, tho' made with other Materials than Galls. First then it may be observ'd, that one need not make an Infusion

or Tincture of Galls in common Water, to try if by their means a new colour will be produc'd. For I am wont to beat them to Powder, and keep them in a Glass (not too big) exactly stop'd, by which means I have them alwaies in readiness to mingle with the Mineral Water, and alter the colour of it, if Galls be able to do it, almost in a trice: whereas to draw the Tincture of Galls with Simple Water, often takes up several hours, and the tinging parts are much weakn'd by being diluted by the *Menstruum*. If you would have a Tincture, the Powder of Galls, ty'd up close in a Ragg, and with it hung in the Liquor, makes the Infusion less muddy. If you be in hast, and have none of the Powder at hand, you may scrape as much of a Gall-Apple, as you need into the Mineral Water.

2. I have observ'd those Parts of the Infusion of Galls (especially if made by heat) that produce the new Colour with Ferruginous Waters, to

to be more apt to fly away than one would think, the Infusion becoming often unfit to alter the Colour of the Martial Waters, whilst yet it self appears sufficiently high colour'd. Upon which account, I choose to make a Tincture of Galls not long before I mind to use it; And if I imploy dry Galls, to take Powder that is not stale.

3. 'Tis no safe way, and may be very erroneous, that is usually taken in mixing Galls or their Infusion with the Water to be explor'd so carelesly, as is wont to be done. For those that are curious to make good Ink, will easily believe, that much of the deepness of the Colour depends upon the Proportion of Galls to the other Ingredient; and accordingly that by putting a much greater, or a much lesser, quantity of Galls, into such a quantity of the Mineral Water, the resulting Colour may be more or less intense. To obviate which inconvenience, I take this course when the occasion deserves it; I make

my Infusion of Galls with a certain weight of the Powder in a determinate weight of Water. As for instance I put about five *gr.* of powder'd Galls, to steep for so many hours in an Ounce of Water. But if I make use of the dry Powder, then I am wont to put three or four grains into an Ounce of the Liquor to be examin'd; which is a way far more certain than the Common, wherein the Ingredients are æstimated but by Guess. I have have mention'd various proportions of powder'd Galls to the same quantity of Liquor, because I have observ'd that there is really a great inequality among the Mineral VVaters in which it may be put; and I have found by Tryal, that in an Ounce of the *German Spaw*, a single grain of Powder would immediately produce a sufficiently deep purple colour.

'Tis an inconvenience, that not only Galls, but the other Drugs hereafter to be mention'd, impart a high Tincture of their own to the common VVater they are infus'd in; and there-

therefore it were to be wish'd, and is fit to be endeavour'd, that we had some Drugg, that without imparting a colour to the common VVater it impregnates, would afford an Infusion fit to strike a blackish or a purple colour with Martial VVaters.

Though it be useful, yet 'tis not necessary, to imploy Galls to produce a colour in the Mineral VVater propos'd. For besides that 'tis known that usually, (tho' not alwayes, as I have try'd,) the same thing may be done, but somewhat more faintly, with Oaken Leaves, we may successfully enough substitute, for the same purpose, some other astringent vegetables, as dry'd Red-Rose Leaves, the Peel, and, (as we have try'd) the Juice of Pomegranates; and (what I find to be a notable stiptick) the blossoms of the same plant, (which are vulgarly call'd in the Shops *Ballaustium*.) To which may be added Myrobolans, Logwood, and some others that need not now be mention'd, whose strong Infusions

have yielded me a Tincture very dark and blackish with some Martial Liquors.

6. In regard that the Galls, or other Drugs, to be infus'd in common VVater, are not alwayes of the same goodness or strength, 'tis adviseable not so to trust to any determinate proportion of the Pigment to the VVater, as not to take in the help of the Eye, to judge by the Colour of the Tincture, whether the Liquor be duely (and not too much or too little) impregnated.

8. Whereas there is an intimation in the Close of this thirteenth Article of the present Sett of Titles, that Animal Liquors may be imploy'd to produce new colours with Mineral VVaters, I gave that hint, not only because 'tis usually observ'd in Martial VVaters, such as those of *Tunbridge* the *Spaw*, &c. that the gross excrements of the lower belly are blacken'd by a commixture of their Metalline Parts; but in *Tunbridge* VVaters particularly I have observ'd, that after the drinking of

larger doſes of them, the root of the tongue, and perhaps ſome neighbouring parts, would alſo acquire a dark colour, by the operation of the tranſient Liquor.

Though the way of trying Mineral VVaters, by the change of colours that Galls produce in them, be uſeful and recommended by being eaſy, cheap, and expeditious, yet I do not take it to be either of that extent, or of that certainty, that 'tis vulgarly preſum'd to be of: For its main, if not only conſiderable, uſe is, to diſcover by ſtriking, or not affording, a black or blackiſh, or at leaſt a purple or a purpliſh, colour with a Mineral Water, to manifeſt the Liquor to be, or not to be, either of a vitriolate, or a ferruginous nature. But there are divers Metalline Ores, and other Mineral Bodies, which not participating of Iron, will not by this way be diſcoverable and yet may ſtrongly impregnate the VVater propos'd. As for example, to try whether if Arſenic were mingl'd with VVater, Galls

would discover it by producing with it a dark colour, I put some of the Powder of them into a Decoction of arsenic, but did not perceive that it gave the Liquor any deeper colour, than it would have done to common VVater. And as the extent of this explorer of VVaters is not very great, so neither do I find the informations it gives us to be so certain, as they are presum'd. For, if I much misremember not, I long since found upon tryal purposely made that another Body of a Metalline nature, and that did not partake of Iron, would with infusion of Galls afford a very dark colour, that might easily, among ordinary Beholders, pass for the colour produc'd by a Martial VVater; and I do somewhat doubt, whether so much as all Liquors impregnated with Iron, will de discover'd to be so, by the colour they afford with Galls; for I have sometimes made such a Liquor with no Mineral Substance in it, save steel or Iron but I did not find it would turn the Infusion of Galls either

blackish

blackish or purple, which made me suspect, that these colours are afforded only by such Martial VVaters, as have been wrought upon more or less by some Acid Salts or Fumes.

9. Unto these things I shall add, that I found that to be a mistake, which is generally taken for granted, *viz.* That the infusion of Galls will certainly discover, by becoming black, (or purple,) if a Mineral Water, that is mix'd with it, be vitriolate; for, *tho'* it be true that if, in the vitriolated VVater, Iron be the only or predominant Mineral, or be at least considerably participated by the Liquor, *yet* if the dissolv'd vitriol be altogether copperish, I found by several Tryals purposely made with a strong solution of Roman vitriol, (wherein Copper is affirm'd to be the only, or to be very much the predominant, Metal,) that it would not with infusion or Tincture of Galls, afford either a black or a blackish colour, but only a thick and muddy one, that was not so much purplish.

It

It comes into my mind upon this occasion that from one of the Northern Countreys of *England*, where there are divers Mineral VVaters, there was brought me by a *Virtuoso*, a good quantity of very whitish Earth, which he suspected to be of a peculiar nature, but could not tell of what. This odd earth being examin'd, I concluded it to contain a considereble proportion of Lead Ore, corroded by some Mineral Salts, and imbody'd with the Soyl; so that if it had been in a place where people had sought for Mineral VVaters, 'tis probable that, finding some peculiarity in the tast of those that pass'd through this Earth, they would have taken it for a Mineral Water, but had been at a great loss to determine what Mineralit did partake of; and perhaps, in endeavouring to resolve the doubt by drinking it, they would have found very bad effects of it. But probably the Sulphureous Spirit to be ere long describ'd in this Paper would have inform'd them, that the Water was

impregnated with a Body of the nature of vitriol, but not of common vitriol. For tho' *Galls* do not give a black, or very blackish, colour with a solution of *Saccharum Saturni*, (which is indeed the vitriol of Lead) resolv'd in distill'd or rain Water. *Yet* I found by Tryal, that this volatile Sulphur did manifestly and presently do it; which Tryal I was fain to take up with, because when I had occasion to consider this matter, I had not at hand the ores of Lead, Copper, &c. And therefore was fain to content my self with the solutions of the Metals themselves in their proper *Menstruums*; it being probable, that the Metalline parts of the Ores would have afforded either the same solutions, or some very like them, in the same *Menstruums*; which consisting of Niter, Sea-Salt, & Vitriol, Bodies that abound in diverse places of the Earth through which Springs flow, the impregnated Water would afford *Phænomena* of the same kind. I made tryals also upon a somewhat fine solution of refin'd Gold,

Gold made in an *Aqua Regalis*, and upon a ſolution of common running Mercury, made with *Aqua fortis*, and in a clear ſolution of Tin, made, not with either of the foregoing *Menſtruums* (for I have not found them to diſſolve it genuinely) but in a peculiar Solvent, (which I have communicated in another Paper,) that does not only diſſolve it readily, but keep it permanently diſſolv'd, as *Aqua fortis* do's Silver, but not Tin. To theſe ſolutions I put Galls, without obtaining any blackiſh colour except from that which contain'd Gold. But with our Sulphureous Liquor we produc'd notable changes of colour, and thoſe in all the ſolutions but one a dark one or tending to blackneſs, and tho' for that reaſon a careleſs eye might judge them indiſcriminately to be blackiſh; yet ſince I well remember that the degrees, or ſome other modification, of the ſame dark colour ſeem'd plainly enough not to be the ſame in all of them, I do not think it impoſſible but that a *very heedful* Beholder

which

(which when I made those Tryals I had no great motive to be) may discern between those obscure colours some little differences, that may much assist him to guess, what metalline substance is contain'd in the Liquor, or at least is predominant in it, if it be a compounded one. And I particularly remember, that the colour that sprang from our Sulphureous Liquor and solution of Tin, was manifestly distinguishable from those produc'd in that of any of the other solutions, being not black or blackish, nor so much as purple, but of a kind of browniſh yellow.

Though I am content that the things, I come from mentioning, should make men cautious and diffident, yet not only I do not despise or slight the use of Galls, &c. even as it it is vulgarly practis'd, but I am apt to think that the way of exploring Mineral Waters by the changes of colour, that may be produc'd in them or by them, when they are mingled with convenient Drugs or Additaments,

ments, may be made of greater extent and use than he, that has read what I have written in the foregoing number, will perhaps be forward to expect. But to make the way of exploring Mineral Waters by colorations, of somewhat more general use and less uncertainty, I would recommend these things to the experimenter,

(1.) It seems very fit, if not necessary, that he look upon the change of colours, both while 'tis producing, and when 'tis produce in a good light and with a heedful Eye. For by this means he may discover several shades or varietys of the more principal colours, and some other circumstances that he could not else take notice of; and which yet may afford good hints (in reference to other Minerals, as well as Martial ones,) to a sagacious observer. And I have sometimes fancy'd, that there may be a kind of Physiognomy of many, if not most, other natural Bodies as well as of humane faces, whereby an attentive and

and experienc'd considerer may himself discern in them many instructive things, that he cannot so declare to another man, as to make him discern them too.

(2.) The Attention here encourag'd may perhaps be made more instructive, by a way that I have sometimes practis'd to vary the Shades, and other *Phænomena* of Colours produc'd with Mineral Liquors. This way consists chiefly in preparing Sheets of White Paper by drenching them in a strong Infusion of Brasil, Log-wood, or some other convenient dying stuff, and then letting them dry leasurely in the Air, which may give some of them, as I have observ'd, a colour differing enough from that of the Liquor look'd upon in a Vial or drinking Glass. Upon this dry'd Paper ye may let fall, but not all on the same place, some drops of the Mineral Liquor to be examin'd, especially if it be of a Saline nature, and by the Changes of Colour, effected by these Drops on the

Parts

Parts of the Paper, they fell and ſpread themſelves upon, a heedful obſerver may be aſſiſted to gueſs, what kind of Mineral impregnates the Liquor, and how much it does ſo; eſpecially if on the ſame Sheet of Paper ſome other fit Mineral Water or idoneous Liquor be likewiſe dropt, that the changes of colour produc'd by the two Fluids, may be ſurvey'd and compar'd together. I alſo practis'd another way ſomewhat differing from this; as the main part of which we prepar'd white Paper, by rubbing well upon it, with a hares foot or ſome ſuch thing, ſome idoneous Powders, eſpecially that of vitriol (whereof for this purpoſe Engliſh ſeem'd the beſt) lightly calcin'd in a gentle heat till it became of a grayiſh colour and friable between the Fingers. By this means 'twas eaſy to make the *Paper* fit for our turn. For the finer parts having lodg'd themſelves in its Pores, without much diſcolouring it when the ſuperfluous duſt was ſtruck off, it became

became capable of affording a variety of Colours, or rather ſhades, ſome deeper and ſome fainter, when I let fall on it ſome drops of differing Martial Liquors. But of the *Examen* of the *Materia medica*, by the changes of colour produc'd in it or by it, more is ſaid in another Paper; and therefore, inſtead of transferring that hither, I ſhall here briefly intimate, that divers variations of colour may be made, *either* by infuſing or otherwiſe mixing, as I have ſometimes done ſomething in the Mineral Water before the tinging ſtuff be put to it: *or* by putting ſomewhat in the Infuſion or Powder of Galls, before it be mix'd with the Mineral Water, *or elſe* by dropping fit Liquors (ſuch as Spirit of Salt firſt; and then Spirit of Urine, or Oyl of Tartar) into the Blackiſh or Purple Mixture of Galls and the Medicinal Water to be examin'd. For by theſe means diverſe variations of colours may be obſerv'd; which, together with ſome other wayes that I have

made use of to multiply them, I have not now leisure to set down.

(3.) It is not convenient to confine ones self to the use either of Galls or Oaken Leaves, but to make use also of Red Roses, *Balaustium*, Log-wood, Brasil, and other astringent vegetable Pigments. For, though some of these give a deeper Tincture than Galls yet, by the diversity of colours produc'd by them in Mineral Waters, an attentive Beholder may, as was lately intimated where I mention'd diversity of Lights and Shades, discover some things that he would not be informed of, or receive any hints of, by the help of Galls or Oaken Leaves alone. Nay I would not have our experimenter imploy none but vegetable substances about his colorations, but sometimes make use of Animal ones, and (more often) of Minerals: Since by this means he may much diversify his Tryals, and increase the number of *Phænomena*, some of which he may probably find instructive. Besides astringent Plants

I have found, and sometimes devis'd, other substances that will turn black as well as Galls, with vitriolated Water; and that not only with those that are richly impregnated with Iron, but also with those wherein Copper alone abounds, as in Roman vitriol. And tho', for certain reasons, I must not now set down a way I have, to discover in a trice both these vitriols, without any Liquor or Tangible Body, yet I shall subjoin, as a kind of *Succedaneum* that may suffice for the present occasion, the way of making a Liquor that will presently turn black with a solution either of Martial or Cupreous vitriol.

"Take equal parts of pure Salt of "Tartar, and either Flowers of "Sulphur, or at least Sulphur finely "powder'd, and good Sal-armo-"niac, reduce the first and the last "to powder separately, melt the "Sulphur over a gentle fire, and by "degrees put to it the Salt of Tar-"tar, stirring them well, to make

"them incorporate and grow red (or "reddish.) Then put this mixture "pulveriz'd into a Glass Retort, or a "cucurbite, and pour on it the Sal-"Armoniac dissolv'd in fair Water, "and closing well the Junctures, "distill all in sand by degrees of a "moderate fire, shifting the receiver "once or twice, because the Li-"quors will be differingly ting'd and "strong; and that which ascends last, "may bring over but very little of "the Sulphur, whose volatile Tin-"cture is yet the main thing we aim "at in this operation.

(4) I do not despair but that he, who were able to make a skilful use of the several Drugs and other Body's, Vegetable, Animal and Mineral, that may produce new colours in or with Mineral Waters, (or in some cases with the substances that impregnate them,) may by their means be also inabled to discover the presence or inexistence of divers other Minerals, some of them salubrious, or at least safe, and some o-

thers

thers either hurtfull, or at leaſt dangerous, that are not taken notice of by thoſe that content themſelves to imploy Galls and Oaken Leaves, in the exploration of the Waters they examine. For ſome of theſe Liquors contain Salts, that having not corroded either Martial or Cupreous Ores or Marcaſites, do not betray themſelves by producing either an Inky or a fainter degree of Blackneſs, or elſe a Purple, with the Drugs made uſe of to change their Colours. Of theſe Salts I have met with more than one ſort, which may be more properly take notice of. when we conſider the Mineral Water and its contents.

12. I think it likewiſe very poſſible, that induſtrious men ſhould find wayes to diſcover, by the help of the change of colours, whether Orpiment or native Arſenick, or the like poiſonous Minerals, do ſo impregnate the Water propos'd, as to make it very hurtful or dangerous, thô not abſolutely pernicious. And as for Sul-

phur, there may be ſeveral Waters that partake of it, without being taken notice of to do ſo. For I remember, that I have ſometimes purpoſely made a Liquor, that was limpid and colourleſs like Spring Water, and which would totally fly up, even with a gentle heat; and yet this Liquor was richly impregnated with a Mineral Sulphur, as I convinc'd ſeveral *virtuoſi* by manifeſt and ocular proofs. So that if Sulphur chanc'd to be combin'd with any Salt or Mineral, of thoſe many ſubterraneal ones that nature hath hid from us, that can ſuppreſs or diſguiſe its peculiar odour, the Water may be conſiderably, and yet unobſervedly, impregnated with it. And yet 'tis like this may eaſily be diſcover'd by the change of colour, producible in ſuch a Sulphureous Liquor by vitriolate Bodies, and other appropriate additaments: Which may be thought the more *probable*, becauſe, thô the Spirit lately deſcrib'd be very tranſparent and totally volatile in the form of a Liquor

ſometimes

sometimes pale enough, yet common English Vitriol, as also that of *Danzick* which is Venereal, will presently turn it of a black or very dark colour. And to add here something more difficult to be perform'd, I have devis'd a way, which I elsewhere deliver, whereby it may appear that even Copper, that hath been melted into a Body, may be so subtiliz'd and disguis'd, as to have a multitude of its metalline Parts made to ascend, with others, in the form of a Transparent Liquor like common Water: And yet by putting to it a little of another substance, as volatile and colourless as it self, it would presently disclose the Copper it contain'd by turning blew as a Saphire.

A Paper refer'd to contain Observations, about the Salubrity and Insalubrity of the Air, under whose 4th Proposition this Process is rang'd.

13. Because *Arsenic* is a very pernicious Drug, and yet has been suspected to be clandestinely mingled with some Mineral Waters, which I thought the less improbable, because

ſome of the Marcaſitical Bodies by which ſome Mineral Waters paſs, are judg'd not to be devoid of *Arſenic*, for theſe reaſons, I ſay, and for this other which makes the mention of it pertinent in this place, that Galls did not (as I elſewhere note,) diſcover at all the inexiſtence of this poyſonous Drug in Water, thô the Liquor were copiouſly impregnated with it, I thought fit to make ſome Trials, that ſeem'd to me likely to diſcover at once the inexiſtence of Arſenic in Water, and ſomewhat of the nature of that dangerous Mineral.

Happening ſome years ago to taſt *Arſenic*, not without ſome little danger and inconvenience, the Taſt of it did not ſeem to me to favour the vulgar ſuppoſition, that its poyſonous nature conſiſts in a highly Acid Salt; whereas its Taſt agrees well with my Conjecture, who ſuſpect it to be of an exceeding corroding or fretting nature, but whoſe corroſiveneſs is *ſui generis*, that is, of a peculiar

culiar kind. Having then made a ſtrong ſolution of Arſenic in common Water, [which does not without ſome skill eaſily diſſolve it,] we mix'd a ſmall proportion of it with the *German-Spaw* Water, and then dropping into this mixture ſome highly dephlegm'd Spirit of Urine, we perceiv'd a light Lacteſcence to be produc'd, and a whitiſh Precipitate very ſlowly to ſubſide.

We found alſo that a little (excellent) Oyl of Tartar *per deliquium*, being drop'd into ſome of the lately mention'd ſolution of Arſenic, produc'd a heavy whitiſh cloud, which preſently ſettled at the lower part of the Glaſs. We alſo put Oyl of vitriol, as one of the ſtrongeſt Acids we know, into the ſolution of Arſenic, but did not perceive, that the Oyl made a Precipitation, or wrought much otherwiſe on it than it would have done upon common Water. And by theſe three Tryals one would ſuſpect, that Arſenic is, at leaſt *ex prædominio*, an Acid Body.

But

But not content with these, we put some of the Arsenical Liquor upon some Syrup of Violets, and found it to change the Syrup, thô but slowly, rather to a Green than a Red or Purple Colour.

We put, to another portion of the same Liquor, some of our volatile sulphureous Spirit, but took notice of no Precipitation that ensued.

For a severer *Examen* we imploy'd a Tryal that we successfully make use of (and have deliver'd in another Paper) to discover such slight degrees of Acidity in Liquors, as by ordinary Tryals are not discoverable; but we could not by this way discern the least Acidity in our Arsenical Solution, but rather a manifest token of an Urinous or Lixiviate Quality.

With the former Experiment agreed very well that which we afterwards made, by putting some of the Arsenical Liquor into a strong solution of common Sublimate made in fair

fair Water. For by this means we had a copious Precipitate, such as might have been expected from an Alkaline Precipitant. And this was not brick-colour'd, as fix'd Alcali's produce with dissolv'd Sublimate, but white, such as Urinous or Volatile Alcalies, (as they call them,) are wont to make with the same Liquor.

The forgoing Tryals having been made at one time, when I was in hast, and not at all fond of having to do with Arsenic (for which reason I caus'd the solution to be presently thrown away to prevent dangerous mistakes;) thô what I have hitherto try'd seems very favourable to our propos'd conjecture; "That thô Ar-"senic be a very corrosive Body, "and perhaps upon that score poyso-"nous, yet its deleterious nature does "not consist only or mainly in a tran-"scendently Acid, nor in a lixiviate "caustick Quality, but in a corrosive-"ness *sui generis*, I mean peculiar "and distinct: Yet I shall forbear to be positive in this conjecture till fur-

ther

ther Tryal, pretending only, by what has been said, *to* show the need of examining the vulgar supposition by further Inquiries, and *to* give some hints towards the finding of Antidotes against this cruel Poyson.

I shall now add that, for the sake of Water-drinkers, I cast about in my Thoughts for some way that might be of *some use*, thô of *no certainty*, in examining a Mineral Water suspected to contain Arsenic. To which purpose, for Reasons which hast forbids me to mention, I pitch'd upon vitriolate Bodies and found that if a little solution of *Dantzick* Vitriol were put to a convenient quantity of Arsenical Liquor, there would presently insue a great change of colour, and a dark Substance would by degrees precipitate it self and settle in the lower part of the Glass. The like effect we found, when we put *English* vitriol, which (having no Copper added in the making, as that of *Dantzick* has,) is either altogether or almost totally Martial, into a considerable pro-

proportion of the Arsenical Solution.

I fear I shall be thought to have dwelt by far too long upon this one (13) Article of our Sett of Titles: But I was tempted to do it, *Partly*, because I thought the Subject seem'd both to merit and to need it, *Partly*, because I thought fit to give an Instance that may shew that even that part of the Exploration of Mineral Waters, that is judg'd to be the most cultivated, hath been but superficially enough consider'd. And *Partly*, too, because my want of health, and my preingagement to some Subjects that I am more concern'd for then I am for that I now treat of, permitting me to make few other than *shorter Notes* upon the particular Articles and clauses of this Scheme of Titles; I thought it not amiss, by referring all the foregoing Observations and Tryals to the same Topick, to give *one Specimen* (thô but an imperfect one) of those that, for distinctions sake, I style *Large Annotations*. And though the

the Title, these belong to, be the Thirteenth in the Scheme (of the II Part,) yet I thought fit to premise these Notes to all the rest ; though divers of them be on Titles antecedent to the Thirteenth, because one or other, of the many Particulars refer'd to this last nam'd Title, may probably be of use to you in considering many of the other Articles of this Scheme, whether they follow the Thirteenth, or precede it.

MAR-

Marginal Notes

For the II. Or Physico-Chymical Part of the Natural History of a Mineral Water propos'd.

Notes on the first Title.

I. 1. THe Article mentions *Actual* coldness and Heat, because we do not here consider that which the Schools call *Potential.*

2. The knowledge of the degree of Coldness in the Water, especially if it be extraordinary, may somewhat assist the Examiner to guess, whether the Spring come from some notable depth under ground before it ascends, or whether it runs through a soyl abounding with Salt-Peter or Sal-armoniac,

moniac, or some such very refrigerating substance.

3. The degree of Coldness or Heat may be estimated several wayes as, if the Water be *cold*, by its having, or not having, the power to coagulate Essential Oyl of Anis-seeds, or that of Fennell seed; & if it be *that*, by its being, or not being, able *to* melt Bodies of somewhat differing dispositions to Fusion, as Butter, Tallow, Bees-wax, *&c.* Or *to* coagulate the whites of Eggs, or *to* boyl Eggs in the Shell, *&c.* But the best way is to plunge into the Water propos'd, or least the whole Ball or globulous part of a good hermetically seal'd Thermoscope, whereon the degrees of cold and heat are carefully mark'd.

Notes on the Second Title.

II. The knowledge of the specifick Gravity of a Mineral Water, may be of great use to him that endeavonrs to discover its nature, not only as this knowledge inables him to distinguish the

the propos'd Water from others, but because it may afford him a considerable and double information. For, by comparing the weight of the propos'd Liquor with that of common Water, he may be, in case the former be heavier (as it usually happens to be) assisted to estimate what proportion of Salt, or Martial, or other Mineral Substance, it is impregnated with. And if it be very light, and much more if it be lighter than common Water, he may probably conclude that the Substance, that impregnates it, is either very small in quantity or proportion, or is not near so gross as is to be found in other Mineral Waters, but of a Spirituous and Volatile nature which is a discovery of no small moment in this affair. And *thô* that may seem a paradox which I here suppose, that a Water impregnated with a Metalline or Mineral Substance should be as light or even lighter than common Water. *Yet* upon Tryal carefully made I have found some Mineral Wa-

ters, as particularly that of *Tunbridge* well taken up, and (thô they be somewhat less light) that of the *German Spaw*, and of some of the *Islington* Springs, to be manifestly lighter than common Water, and some taken up at *Tun-bridge* I found to be lighter than common Water, even purified by Distillation.

And thô it be very hard to conceive, yet I think it not impossible, that a Subterreneal Substance, that impregnates Water, should be lighter *in Specie* than it: but yet I would not refer this surprizing Levity, in all cases, nor all of it in most cases, to the admixture of lighter Corpuscles, because some Tryals justify'd the suspicion I had, that much of the Comparative Lightness proceeded from this, That the Mineral Water was imbued with a smaller quantity of vulgar or culinary Salt, than common Water uses to contain. But yet these Tryals did not satisfy me, that this paucity of common Salt was the sole or adequate cause of the lightness of the mentioned Waters. But,

But, to discover such minute differences, one must have good Instruments, and indeed, to speak freely, there are few, upon whose Reports I durst confidently relye, for the Specific Gravity of Mineral Waters. For to weigh Liquors any thing exactly there is requisite more Heedfulness, and more Skill, and better Instruments, than are easy to be met with together, and than we usually imagine. And, when Physicians and others weigh Mineral Waters, they are wont to do it in some Apothecary or other Trades-mans Shop, where, if the Ballances be small, the Vessels and the Water are commonly too heavy for them, and oftentimes wrong them. And if, as is usual, the Bottles or other vessels be great, they require far better Ballances than are usually imploy'd in the Shops of Apothecaries or Grocers, whose Ballances a Critical Examiner will too often find to be far from being accurate, insomuch that usually, without at all altering the weights, thô perhaps not

great ones, he may easily make which Scale he pleases manifestly preponderate, and continue in that position, and may as easily afterwards give the other Scale the same advantage: The diligent and experienced Mathematician *Mersennus* much complains of the difficulty he found to weigh Liquors exactly, even by the help of his Nicer Instruments. The accurateſt way, I know, is by comparing the differing weights that the same sinking Body has in common Water, and in the Liquor propos'd. But this way (which I elsewhere circumstantially deliver) requiring, besides good Instruments, skill in Hydrostaticks, is practicable but by few. And the way of comparing Waters, by the greater or lesser sinking of the same Cylinder or other swiming Body into them, is scarce accurate enough. Wherefore I chose to make a very skilfull Artist blow, at the flame of a great Lamp, a thin round vial with a flattish bottom, that it might stand upright, and be very

very light, and this was furnish'd with a neck as large as a Goose quil, drawn very even into a hollow Cylinder of above 3 Inches long, and fitted at the top with a little Gap, that hinder'd the Water from ascending above the due height.

This Glass contain'd ʒiiiʃs and 43 grains of common Water, and yet when empty, weigh'd but ʒvi+42 grains: So that I could use it, when full of Liquor, in such a Ballance, that the addition or detraction of half a Grain, or less, would make either Scale preponderate. The length and evenness of the stem was design'd for uses not needful to be mention'd here; where it may suffice for my purpose to say, that this Glass was judged capable of holding Water enough for not uncurious Tryals, and yet not to be, thô well fill'd, too heavy for a tender Ballance. In this Vessel therefore we carefully weighed several Liquors (whose Gravity belongs not to this place) and among them diverse Mineral Waters, some

of which, at leaſt known here at *London*, were found to be of the annexed weights.

The Glaſs being fill'd with ſeveral Liquors to the ſame height, and weighed in the ſame Ballances.

	Ounces dr. gr.
Common Water was found to weigh	3—4—43
Common Water diſtill'd	3—4—41
Acton Water	3—4—48½
Epſom Water	3—4—51
Dulledge Water	2—4—54
Straton Water	3—4—55
Barnet Water	3—4—52
North-Hall Water	3—4—50
The *German Spaw* Water	3—4—40
Tunbridge Water	3—4—38
Iſlington Water from the Muſick Houſe	3—4—36
Iſlington Water from the Vault with Steps	3—4—39
Iſlington Water from the Cellar	3—4—39

By this ſhort account it may appear, that, as divers Mineral Waters (that contain Sal's in them) are conſiderably heavier than Common Water,

ter, ſo ſome, eſpecially Ferruginous Waters, are impregnated with ſo fine a ſubſtance, as to be lighter than common Water.

Notes on the Fourth Title.

IV. This Article may, in divers caſes, give ſome light to the diſcovery of the kind of Soyl, through which the Water has paſs'd; and is alſo uſeful to diſtinguiſh the *Spontaneous reſidence*, if I may ſo call it, that the Liquor lets fall by meer ſtanding, from that which they call the *Caput Mortuum*, that remains after the total evaporation of the Water; by which means alſo the weight of this laſt reſidence may be more truly known. Beſides ſome other Mineral Waters, I found that the *German Spaw* Waters, brought very well ſtop't to *London*, afforded by long ſtanding a pretty quantity of Terreſtrial ſubſtance, that look'd almoſt like yellow Oker, and perhaps was of great affinity to it in nature. 3. That clauſe in the Article,

thô the Liquor be kept from the Air, was therefore set down, becauſe I had found by Tryals, that ſome Liquors, by being expos'd to the free Air, would have copious, and ſometimes ſurprizing, ſubſtances ſeparated from them; as if the Air contain'd ſome Precipitating Salts, fit to work on the Liquors, ſo as to make in them ſuch notable ſeparations.

Notes on the Fifth Title.

V. An accidental weakneſs I had, in my eyes, when I had the beſt opportunity to endeavour ſatisfying my ſelf about this Inquiry, forc'd me to leave the proſecution of it to others. Only two things I ſhall take notice of on this occaſion: *One* is that, having caus'd one that had young Eyes, and was accuſtom'd to make uſe of ſuch Microſcopes as are mention'd in the Article, to look upon ſome Mineral Waters through them, he ſaid he could diſcern no difference between them and common Water. Notwithſtanding

ing which the Tryal ought to be repeated by various persons, on several Waters, with differing Engyscopes, and in differing Lights, and other circumstances. The *other* is, that whereas it is by divers learned men objected, against the goodness of these magnifying Glasses we now make use of to look on Liquors, that the little Bodies that the ingenious, Mr. *Lewenhoeck*, and since him divers other *Virtuosi*, have observ'd in Water wherein Pepper has been infus'd, are not, as he pretends, living creatures, but little inanimate concretions, that are casually form'd, and carry'd to and fro in the Liquor: To convince these Doubters, of whose number I was my self at first inclin'd to be, I devis'd the following experiment: Having laid, upon the magnifying Glass, a part of a drop of Water, wherein I could see store of these little Animals frisking up and down, we put to the Liquor, with a bristle or some such very slender thing, part of a drop of Spirit of Salt, which, as

was

was expected, presently kill'd these little tender creatures, and depriving them of their Animal Motion, left them to be carry'd so slowly to and fro in the Liquor, as to make it visible that they were then dead and had been before alive.

Notes on the Seventh Title.

VII. 1. The Odours of divers Mineral Waters are best judg'd of at the Spring-head or other Receptacle, whence some of them being remov'd scarce afford any Odour at all (perceptible by us men.)

2. Perhaps the Sulphureous scent, that is sometimes, perceiv'd in *Tunbridge* and some other Waters in their sources, may in part proceed from loose Exhalations, that casually happen to be mingled with the Waters, but do not constantly belong to it.

3. The winy odour is mention'd among others: Because I am credibly inform'd

inform'd that, in *France*, there is a Mineral Spring, if not more or less than one, that has such a smell.

4. I mention the *Bituminous* Odour, distinctly from the *Sulphureous* because men are too apt to confound them, and take all stinking Mineral Waters for *Sulphureous*, whereas divers are manifestly *Bituminous*; as may be gather'd, to omit other signs, not only from their proper odours, but from more or fewer drops of *Petroleum*, or a kind of course *Naphtha*, that are found swimming upon the Water.

5. I think it also not unlikely, that sometimes a Spring may partake both of *Sulphur* and *Bitumen*, mingl'd together by the *Subterraneal* Heat, since I have found that I could easily enough melt and incorporate these two substances here above ground.

Notes

Notes on Ninth Title.

IX. 1. This is an almoſt neceſſary Article becauſe many Perſons, that drink Mineral Waters, cannot well, either for want of ſtrength or conveniency, repair immediately to the Spring-head, but are oblig'd to drink them in their Beds or their Lodgings, and perhaps to have them tranſported to a great diſtance, or even to another country. 2. Many Purging Waters are found to retain their Laxative vertue, and that perhaps for a conſiderable time, thô they be tranſported to places diſtant from thoſe they riſe in. 3. In ſuch Ferruginous Waters, as are lighter than common Water, I found a manifeſt difference in reference to tranſportation: For moſt of them, even ſuch as will bear removing, have ſomething of freſhneſs and quickneſs at the Spring head, (perhaps from ſome Spirituous and Fugitive Exhalations, that there ariſe with them, but preſently vaniſh,) that they

they have not any where elſe. And ſome do not only loſe this briskneſs by being remov'd, thô in veſſels well ſtop'd, but they loſe alſo the power of producing, with the powder of Galls, a Purple colour, as I found by Tryal purpoſely made in more than one of theſe Mineral Waters, which, to prevent fraud, I ſent for to the Springs themſelves by ſervants of my own: For thô theſe carryed their Glaſs Bottles along with them, and had no other Errand there but to fill and ſtop them carefully yet, by being tranſported leſs than one league, I found them ſo alter'd, that they would no longer make a Purpliſh colour with powder'd Galls, but a deep reddiſh one; whereas the *German Spaw* Waters did almoſt alwayes here in *London* afford me, with the ſame Powder of Galls, a rich Purple Colour. And *Tunbridge* Waters afforded me the like, but not ſo deep a one, when I receiv'd them at *London* very well ſtopt. 4. This laſt clauſe was not to be omitted, becauſe the exact

or

or negligent closing of the vessels, wherein such Waters are transported, is a circumstance of great moment. For more than once I receiv'd at *London*, Waters sent me from *Tunbridge* by Physicians themselves, (who us'd at least a moderate care in putting them up,) which yet would by no means afford with Galls a purplish Colour. And I found that even the *German Spaw-Water* would almost presently lose its capacity of being made Purple by Galls, if it were considerably heated. 5. But the same Spaw-Water being, in Summer time, kept all night in an open Vessel, did the next morning till it was late, if not till Noon, retain a disposition to be made Purple by the admixture of Galls; but that disposition it lost before the next day.

Notes

Notes on the Fifteenth Title.

XV. 1. Becauſe it often happens, that men have not the leiſure and the conveniency totally to evaporate the propoſed Mineral Water, it may be an uſeful thing, to be able without evaporation to diſcover, whether it contain any common Salt and, if it do, to make ſome eſtimate, how copiouſly or ſparingly the Liquor is impregnated with it. This might eaſily be done, with nicety enough, if I were not by very juſt Reaſons reſtrain'd, for a while, from communicating that way of examining the ſaltneſs and freſhneſs of Waters, of which I did, by the Kings command, ſhow his Majeſty ſome proofs, whereof mention was preſently after made in the printed Gazets. But till it be free for me to impart that way to the publick, I ſhall only intimate, that ſome gueſs may be made at the Saltneſs of Waters, by obſerving, whether they will lather with waſh-balls or Soap,

and,

and, if they will not, what quantity of curdled matter they will produce; as also, whether the Waters will serve for washing of Linnen, and will boil Peas tender? Which two are the most usual wayes that many Sea men take to examine the goodness of unknown Waters by. In divers Purging Waters this way may be difficult to be practis'd with certainty, because of other Salts that may be predominant in them; but in the Examen of lightly Ferruginous Springs it may be more rely'd upon. 2. It may not be unworthy observation that, when I made use of my own way of examining the Saltness of Mineral Springs, I did not find even the lightest sort of them devoid of common Salt; which I found, but not in equal proportions, to be contain'd, not only in the several Waters of *Islington*, *Hamstead* VVater, and, if I misremember not, in some others, but also particularly in *Tunbridge* VVaters, and those of the *German-Spaw*, which I did not much wonder at, because I had long known

known, that more or less of common Salt is very usually harbour'd, thô not observed, in many Soils, through which all sorts of Springs, and consequently Mineral ones, have their course.

Notes on the Sixteenth Title.

XVI. Thô *Acidity* be so usually a manifest Quality of Mineral Waters, that Authors are wont to divide them into *Acidulæ* and *Thermæ*, yet I have found, by several Tryals, that 'tis not near so easy as men presume, to find a manifest Acidity in all Mineral Waters, that are not Sulphureous or Hot. For several Ferruginous Waters, having probably spent the Acidity they had upon the Iron Ore, which they dissolv'd in their passage, retain so little Acidity, that 'tis hard to discover they have any, either by their working upon Coral, or by any conflict with Spirit of Urine, or the like, or by mixing them with Syrup of Violets, to change the colour of it;

insomuch that sometimes I should have concluded some such Waters to have no Acidity at all, if I had not had a way of discovering a far less degree of it, than I could discern it to have by other Tryals. The circumstances, that made this way of examining so critical, will cost me too many words to set down here, and I have done it in another Paper expresly written, of the way of discovering the Qualities of divers Bodies, by changes of colour made in or with them: And therefore I shall here but briefly tell you, that I discover the Acidity of Liquors by their operation upon the colours of an Infusion of *Lignum Nephriticum* made in Lympid Water, (and order'd after a certain manner.) By this means I found the *German Spaw* Water to retain a little Acidity, even here at *London*; but more than one of our own Ferruginous Springs did not, even upon this Tryal, appear to have any. And (which some may think strange) I did not find even some of the Purging Springs, particularly

larly that of *Acton*, to have any discernible Acidity.

Notes on the Twentieth Title.

XX. The Scope of this Inquiry was twofold: The *first*, to discover whether a change of Texture would notably alter the Qualities of the Liquor, when the Hermetical Seal hinder'd the Avolation of any Saline, Ferruginous, or Spirituous parts: And the *other* was, to see whether such an Agitation, by heat, as in the open Air would, as I had found, deprive the *Spaw* Water of the vertue of making a Purple colour with Galls, would cause any manifest separation of parts in the Liquor, and make any grosser substance to precipitate or subside. But thô we did twice (not without difficulty) make the experiment with *Spaw* Water, yet we made it without success. For the first time the Glass broke at the bottom, before the Water we immers'd it in was near boyling hot. And thô the other Glass resist-

ed longer, and indur'd a greater heat, yet in not very many Minutes that alſo broke at the bottom. Which diſappointments a faithful Hiſtorian ought as little to conceal, as better ſucceſſes. And I chuſe to leave this 20th Article of Inquiry in its place, among the reſt of the Titles, becauſe poſſibly ſome other may be more happy, than I was, in endeavouring to anſwer it. And I hold it not amiſs, in drawing up Platforms of Natural Hiſtory, to ſet down what Queſtions we think fit to be propos'd to nature; becauſe we cannot be ſure, before Endeavours for Tryal be us'd, whether the thing to be attempted be practically performable or not.

Notes

Notes on the Twentyſixth Title.

XXVI. 1. Divers wayes may be propounded to diſcover which of the Qualities, mention'd in this Article, is predominant in the Salt to be examin'd; but I confeſs I ſomewhat doubt, whether theſe waies of Tryal be ſo certain, as many will be forward to think them. 2. If Acidity be gueſs'd to be predominant in the Salt propos'd it will probably appear by ſuch waies as theſe. *By* the Taſt, odour, or both: *By* working upon Coral or Crabs eyes finely powder'd: *By* curdling of Milk: *By* making Syrup of violets reddiſh: *By* the power of deſtroying the blew colour of the Infuſion of *Lignum Nephriticum*: *By* not being Precipitable by Potent Acid Liquors as Oyl of Vitriol, Spirit of Salt; and *by* being Precipitable by Oyl of Tartar *per deliquium*, as alſo by ſtrong Spirit of Urine, and other volatile Alcaly's, as they are call'd. But, as I was noting above, I doubt whether theſe proofs be abſolutely

absolutely certain; for, if I mistake not, I found some Purging Mineral Waters that would not give even so slight a proof of acidity, as to destroy the blewness of the *Nephritic* Tincture: Which yet would curdle Milk and turn it to a kind of Posset; and, on the contrary, I found that some *German-Spaw* Water would not curdle Milk, & yet would readily deprive the newly mention'd Tincture of its ceruleous colour; which yet I did not find that some of our *English* Ferruginous Waters were, at least when brought me to *London*, able to do.

3. The predominancy of an Alcaly, in the Salt of a Mineral Water, may be probably discover'd by such waies as these. *By* the Lixiviate Tast, Smell, or both; the former of which may be observ'd in the true Niter of the Ancients, (which I have had brought me from *Ægypt*, and a neighbouring Country, whose name I do not now remember:) *By* the turning of Syrup of violets green: *By* the Precipitation

tation of solution of sublimate made in Spring-Water: *By* an effervescence or conflict with some potent Acid, as *Aqua fortis*, or well dephlegm'd Sprit of Salt: *By* heightning the red Tincture of Logwood or Brazil, drawn with common Water, to which, may be added a Nicer way or two that I have elsewhere mention'd. But I propose these waies but as appearing rational, upon the score of my having successfully try'd them with other Saline Bodies that were Alcalisate. For as to those Mineral Waters, I have had occasion to examine, I do not remember I have yet met with any, wherein an Alcaly was predominant. 4. But perhaps farther Inquiry will discover to others here in *England*, what I have not yet met with: And I doubt not but that there are, in divers places of the Earth, Salts of an Alcalisate nature. And I presume that, if the *Egyptians* were any thing curious of such things, they would find, among their Springs or Wells; divers Waters impregnated

with them. For I found by Tryals, purposely made upon *Latron*, as some knowing men call the true Egyptian Niter, presented me by an inquisitive Ambassador who came out of the East, that the native Salt exhibited divers of the same *Phænomena* that other factitious Alcali's do. And some Salt, afforded by the famous Waters of *Bourbon* in *France*, being brought me thence, with a desire that I would examine it, I found it to be evidently Alcalisate; insomuch that it would make a conflict with Acids, and presently turn Syrup of violets green. 5. If we suspect Vitriol to be much predominant in the Saline part of a Mineral Water, we may endeavour to discover it by such wayes as these. *By* its blackning a Solution of Galls: *By* its vomitive operation upon the Drinkers, thô this may sometimes be an uncertain way especially because an invisible permixture of Arsenic, or or perhaps Arsenical Fumes, may give the Water they impregnate an Emetic Quality: *By* putting Alcali's

to

to a ſtrong ſolution of the ſuppos'd Vitriol, and obſerving whether it will afford a yellow or yellowiſh Precipitate, if Salt of Tartar or Spirit of Urine be dropt into it. By taking notice, whether a Sulphureous Spirit, eſpecially ſuch an one as I formerly told I had made thô not here deſcrib'd, will make a blackiſh or a very dark colour with it, as I firſt gueſs'd, and then found it would do with ſeveral vitriolate Liquors, and even with one, to make which we had diſſolv'd but one grain of a Natural Vitriolate ſubſtance in above four or five thouſand times its weight of Syrup or Water. But in the parts about *London* I remember not that, in any of the Waters I have made Tryals on, I have found Vitriol to be predominant, or to be ſo much as a manifeſt Ingredient: Which ſeem'd to me the more remarkable, becauſe ſeveral parts about this City are not deſtitute of Marcaſites, the Parents or Wombs of Vitriol. Since the writing of theſe Papers, being caſually viſited by a diſcerning

Stranger,

Stranger, who had a particular occasion to take notice of the Residences of many of the Mineral Waters of *France*, his native Country; he answer'd me that he never met with any that was manifestly Vitriolate; and he seem'd to be of opinion, that no Vitriolate Spring had yet been discover'd, among the many Mineral ones that are known to be in that Country.

7. Since we so rarely meet with either manifestly Acid, or evidently Alcalisate, Salts in our *English* Mineral Waters, it may deserve a serious Inquiry, what other Salts they may be impregnated with; and especially from what Salts, the Purgative vertue, that is found to belong to many of them, as *Epsom*, *Barnet*, *Acton*, *&c.* do's proceed? Common Salt indeed, as is already noted, I have found tokens of in the *German Spaw* Water; and in all the *English* Mineral Waters, I had occasion to try, not one that I remember excepted. But I did not find that common Salt was so copious in any of them, as to disclose it

self

ſelf by Chryſtallizing in Cubical grains. And the way, I made uſe of, to examine the Saltneſs of the Water without Cryſtallization, is not equally certain in all ſorts of them. And becauſe I had not ſtore enough of theſe Liquors, to evaporate them in large quantities, thô I could not diſcern, in the clear Salts they afforded, either Vitriol, or Salt Peter, or Allom, or even common Salt, by their peculiar and genuine Figures; yet I dare not confidently ſay, that none of our *Engliſh* Mineral Springs abounds with any of thoſe Salts. But as far as I can gueſs, by the Tryals that I have hitherto had opportunity to make, I am apt to think that the Salt, that is found in our Purgative Waters, and and in ſome of them copiouſly enough, dos not belong to any one known ſort of Salts, but is either of a ſort, for which as for many other Minerals, we have yet no name: or, which ſeems more probable, is a Salt of a compounded Nature, made up by the coalitions of ſome or all of the

the Salts above mention'd, and perhaps of some other, as yet nameless, Subterraneal Salt that the Spring insolves in its passage, That two Bodies, which are neither of them Cathartic, may, by a change of Texture, wrought in one another, compose a third Body, that is briskly purgative, I have shewn in another Paper. Besides having formerly had occasion, in order to the resolution of a certain doubt I had entertain'd, to burn Salt of Tartar with about a double weight of common Sulphur, I thence obtain'd, as I expected, a Neutral Salt, that had peculiar Qualities differing from those of the Bodies imploy'd to make it up: And talking of this Salt with an ingenious Empyrick, he told me it had a Quality I had not mention'd, and that a very useful one, since in the dose of half a dram, or in some Bodies, being taken in Wine or Broth, it would considerably, and yet gently and without gripings, purge. And without the help of Salt of Tartar have sometimes

made

made out of common Sulphur, a Chrystalline Salt of a somewhat Vitriolate Tast, the like to which might possibly be made under ground, where there are Subterraneal fires, tho perhaps not observed nor suspected, since we made this Salt without adding any thing to the Sulphur, only by the help of Fire and common Water. And I remember that a great *Virtuoso*, several years ago, brought me, in order to an *Examen* he desir'd I should make of it, a certain Salt afforded by a Spring in or near his land, which I remember was in the West of *England*, tho I have forgot the name of the County: Which Salt no Body knew what to make of, but I quickly told him, I took it to be of the nature of the *Sal mirabile Glauberi*, and predicted that in such Tryals it would afford such and such *Phænomena*, which accordingly came to pass. And I thought that, if opportunity had not been wanting, this Salt would have appear'd Purgative, as some factitious Salts that resemble it in

transpa-

transparency, colourlesness, and Figure have been observ'd to be.

Notes on the Twenty seventh Title.

1. 'Tis surprizing to observe, how great an inequality one may sometimes meet with in the proportion that the same quantity, of two differing Mineral Waters, bear to the *Caput Mortuum* they respectively afford: For a pound, for instance, of one may, after evaporation, leave behind it perhaps more drams of dry substance, than a pound of the other will leave behind it grains. But because I have no notes of the considerablest Instances of this kind, that came to my knowledge, I shall add only by and by the Product of a more recent Tryal. 2. As far as I have hitherto observ'd, those *Ferruginous Waters*, that are not heavier than common Water, and in most Drinkers prove but diuretick, afford but very little *Caput Mortuum*, or dry Substance upon the total Evaporation of the Liquor

quor, whereas Mineral Waters, that are purging and manifestly more ponderous *in Specie* than common Water, leave, upon Evaporation, a considerable quantity of residence, thô some far less than others. 3. At once to explain, and partly prove, what I have been saying, I shall here recite that, from a pound of *Barnet* VVater (which is known to be purgative) slowly evaporated, we obtain'd a Dram of VVhite Powder. But from the like quantity of *Tunbridge* VVater, we obtain'd but about one grain of *Caput Mortuum*: And, if I misremember not, we had but about a grain and a half from 25. Ounces of the *German Spaw* Water. 4. It may seem scarce credible to many, that so small a quantity of matter, of which perhaps not one half is Saline, or Metalline, (the rest being terestrial,) should impart a manifest vertue to so great a proportion of VVater. But this difficulty did not much trouble me, who have purposely made divers Experiments, to discover how small

ſmall a proportion of Mineral matter may ſuffice, when diſſolv'd, to impregnate common VVater. I remember I took one grain of Iron ſtone, caſually found near the Springs at *Iſlington*, (from which Mineral 'tis probable thoſe VVaters derive their vertue,) this being open'd by the fire, and diſſolv'd as far as it would be in a little Spirit of Salt, we let fall a drop or two of the yellowiſh ſolution into a great proportion of Infuſion of Galls, to which it preſently gave a deeper colour than *Tunbridge* Water, or even the *German Spaw* VVater, was wont to give here at *London*, with the Powder of Galls: So that we gueſs'd that, if we had then had at hand a competent quantity of the infuſion, the remaining part of the Martial Solution would have been able to colour ten times a greater quantity of the Infuſion, than our Tryal was made upon. This will be eaſily believ'd by him, that ſhall conſider an Experiment, we afterwards made to the ſame purpoſe, which

which was this, VVe dissolv'd a half grain of a good Marcasite, taken up not far from *London*, in a small quantity of Spirit of Niter, (which for a certain Reason I made choice of, thô other Acid *Menstruums*, as *Aqua-fortis*, and Spirit of Salt would have dissolved the Mineral.) This small solution we put into a pound of pretty high Tincture of Galls, made by infusing them in common Water, and finding, as we expected, that this mixture, grew very dark, we fill'd a Vial with it, and emptying that Vial into a larger Glass, we fill'd the same Vial three times with common Water to dilute it; notwithstanding which this new mixture, being put into one of our usual Glasses, appeared of a colour much deeper than that which the Water of *Tunbridge*, or the *German Spaw*, had formerly given with the Powder of Galls: So that probably, if another Vial of common Water had been added, it would yet have afforded a purple colour, if not a deeper; so that one part of dissolv'd Mar-

 casite

casite communicated a Tincture to (61440) sixty one thousand four hundred and forty parts of Infusion of Galls. And that which makes this Experiment more considerable is, that this small quantity of Marcasite was not it self all Martial or Metalline: For from our *English* Marcasites, as well as others, I have obtain'd a pretty quantity of Sulphur like common Sulphur; besides that they afford a not despicable quantity of Terrestrial Substance, about whose nature I have not yet satisfy'd my self. 5. I shall now add this reflexion that, since the Marcasite impregnated so much Water with its corporeal Parts, if I may so call them, obtain'd by bare dissolution, it seems highly probable, *that* the same quantity of Liquor may be impregnated by a far less quantity of Mineral matter, attenuated into a kind of Spirituous state, by being rais'd in the form of Fumes or exhalations; and *that* imperfect or embryonated Iron may be so, will scarce be deny'd by them

them that consider the way that I have, in another Paper, deliver'd to make Iron manifestly emit copious Fumes, without the help of external Fire. And if it be with some such Spirituous and volatile Exhalations, that a Mineral Water, as that of *Tunbridge* or of *Islington*, is impregnated, 'tis not hard to conceive that they may easily lose their chief vertue, by the avolation of most or many of their fugitive Parts, upon their being remov'd to a distance from the Spring head. And to make it probable, that vitriolate Corpuscles may be made to ascend, without losing their nature, I shall here mention an Experiment, that I devis'd to give some light in this matter. I had often found by Tryal, that a Spirit, richly impregnated with volatiliz'd Sulphur, would with vitriol, whether in the form of a powder or a solution, produce in a trice a very dark or blackish colour: And guessing that, in Mercury turn'd by the addition of Salt and Vitriol into corrosive sublimate, many of the Vi-

triolate Corpuſcles might aſcend with the Mercurial ones, I took ſuch a Volatile Sulphureous Tincture as I have been mentioning, (which for this purpoſe ought to be deep,) and having dropt it upon good Sublimate, I found it turn preſently of a very opacous colour. To ſhow alſo that, to make a great dilatation or diſperſion of the Martial Corpuſcles of an Ore or Mineral, there needs no Spirit of Salt, or the like diſtill'd *Menſtruum*, I procur'd from a copperas-work, (or place where vitriol is made by art,) ſome of the Liquor they imploy, before they caſt in Iron, that being corroded by it, it may increaſe the weight, and give ſolidity and ſome other Qualities to the deſigned Vitriol. Now *thô* this Liquor be made, without any Chymical *Menſtruum*, barely by Rain or Snow-Water, that impregnates it ſelf with Saline or Metalline Particles in its paſſage through Beds of Marcaſites, that lye expos'd to the Sun and Air; *yet* in this Water ſuch numbers of Martial Corpuſcles

cles are disper's'd that, having shaken four drops of it into 12 Ounces and a half of common Water, this Liquor, as I expected, was thereby so impregnated, that with powder of Galls it presently produc'd as deep a colour as good *Tunbridge* Water would have done. So that, supposing a drop of this Liquor to weigh about a grain, (as by some Tryals purposely made we found it to do,) it appears that one part of the vitriolate Water was able manifestly to impregnate 1500 Parts of common water. And yet of these 4 drops or Grains of Vitriolate Liquor, a considerable part may very probably be concluded, from the way of its production, to have been Rain Water, as will easily be granted when I shall have added, that, to examine this supposition or conjecture, we slowly evaporated some Ounces of the Vitriolate Liquor, and found that the remaining dry Substance did not fully amount to the 4th part of the weight of the whole. At which rate 'twas easy to conclude, that one

grain of Vitriolate ſubſtance would have been found capable of ſo impregnating ſix thouſand times its weight of common Water, as to make it fit to produce with Galls a purple Tincture. We afterwards found, upon Tryal purpoſely and warily made, that the experiment will hold, thô the proportion of the Water, to the grain of tinging ſubſtance, ſhould exceed that lately mention'd, by the weight of ſome hundreds of grains.

TITLES.

For the Natural Hiſtory of a Mineral water propos'd. Conſider'd as a Medicine.

(Being the III. Part of the deſigned work.)

SECT. VI.

THough the effects of a Mineral Water upon Humane Bodies, as well as upon other Subjects, may challenge

challenge a place in the Natural Hiſtory of it, *yet* becauſe the Titles of this Third Part of this Scheme, for the moſt part, directly regard the cure or prevention of diſeaſes, which are held to be the proper Offices of Phyſicians as ſuch; I forbore to make any comments upon the particular Titles of this Part of our Hiſtorical *Idea*, contenting my ſelf, for the ſake of thoſe that are ſtrangers to Platforms of Natural Hiſtory, to have ſet down a *ſeries* of Titles, which may point out to them what particulars may be fit for their Inquiry, and furniſh them with heads whereto they may refer, and Receptacles wherein they may lodge what, upon Tryals or otherwiſe, they ſhall meet with worthy of obſervation. And ſo the accounts, that ſhall be given on theſe Subjects, may be ſomewhat more diſtinct, and leſs incompleat.

To what Temperaments and conſtitutions the Mineral Water propos'd is the moſt proper, to what leſs pro-

per, and to what noxious or inconvenient ?

In what ſtated Diſeaſes, and in what particular caſes, the Mineral Water is proper, or to be ſuſpected of being dangerous, if not certainly hurtful ?

What difference there is, if any, between the Water taken up and preſently drunk at the Spring it ſelf or other receptacle, and that which is carryed to ſome diſtance off, whether in open, or in well ſtop'd Veſſels ?

Of the manifeſt Operations of the Water in thoſe that take it, whether it be by vomit, by ſeige, by Urine, by ſeveral, or by two, or all of theſe waves.

Whether any occult vertues, or other hidden Qualities, can be diſcovered in the Mineral Water ? And if any, what ?

What variation, in the effects of the Mineral Water, proceeds from its being drunk all of it quite cold, or hot, or lukewarm, or one part when 'tis in

one

one of those tempers, and the rest when in another ?

Of promoting or facilitating the operation of the Water, in some by taking it in Bed, and in others by Moderate exercise.

What assistance may be given to the operation of the Water, by giving with it, especially in the first draught, something to make it pass the better, or to correct its Crudity, or to strengthen the stomach and Bowels ?

What advantages may accrue, from preparing the Patients Body before he enters upon his course of drinking the Waters ? And what inconveniences may attend the neglect of such preparation especially in gross, foul, or much obstructed Bodies ?

Of the assistance the Water may receive by gently purging Medicines, discreetly given from time to time.

Of the best Dose, or quantity of the Water, to be taken at once; of the compass

pass of time wherein it should be all drunk; and of the gradual increasing and lessening the Dose at the beginning, and sometimes before the end, of the whole space of time appointed for the taking it.

How much the greater or lesser length of time, spent in taking the Water, conduces to its good Effects? and what is the fittest measure of time to continue the drinking of it, respect being had to the Patients strength, Disease, the time of the year, the accidental temperature of the Air, and other considerable circumstances.

Whether the drinking of the Mineral Water, for several years together, be found almost necessary, or more beneficial than to intermit it sometimes for a year or two, or perhaps longer, and then to return to the use of it?

Of the Diet, as to meat, drink, exercise, sleep, &c. That ought to be observ'd by those that take the Water, and of the inconveniences that are

are wont to follow the neglect of it.

Of the signes that declare the Water to work kindly and effectually, and of the Tokens of not doing so, and those of its being already hurtful or likely to prove so.

Of the Inconveniences or unwelcome accidents (if there be any, as usually there is) that have been observ'd to happen, during, or some time after, the drinking of the Mineral Water, especially to Persons of such constitutions, or that are in such and such circumstances, and of the waies to prevent or remedy such inconveniences.

Whether there be any necessity, or great use, of taking Physick after one has done drinking the Water? And if there be, what are the fittest times and medicines to be imploy'd for the prevention of any bad effects of it, and what is the danger of neglect to make use of them?

VVhether and how the Mineral VVater may be usefully given by being

being simply commix'd with other Liquors or Bodies, as by boiling meat in it; or by receiving, together with the Additament, a further preparation, as when the VVater is mingled with VVine, or some other Drink; when with Milk 'tis made into Posset drink; when brewed with Mault alone, or with that and hopps, 'tis turn'd into Ale or Beer?

VVhether any such saline, or other, substance may by evaporation Inspissation, Calcination, &c. be extracted, or obtained, from the Mineral VVater, as being given in a small Dose, may be substituted, as a *Succedaneum* to large quantities of the Water as nature affords it?

Of what uses (if of any) the Mineral VVater is, when outwardly apply'd, as by washing sore Eyes or Ulcers, bathing in it, &c. And whether the mud, or Sediment it leaves, where it passes or stagnates, being externally apply'd, have the same or other Medicinal vertues, and, if so, how the mud is to be administred

miniſtred to make it exert them.

Of ſome Mechanico-Medical Trials, that may be made upon Animals, to help us to gueſs at the Qualities of the Mineral VVaters, as by injecting it into the veins of a Dog, to try whether it will coagulate his Blood, or make it more fluid, or operate powerfully by Vomit, Siege, or Urine: as alſo by keeping a Dog very long without allowing him any other Drink at all than the Mineral VVater.

But I propoſe ſuch Particulars, as are mention'd in this Article, but as Analogous Experiments, or *Succedaneums* to Tryals that ſhould, but cannot well, becauſe of the worthineſs of the Subject, be try'd in living Humane Bodies. And indeed all the Titles of this third part of our deſign'd Hiſtory, belong porperly to Phyſicians; many of whom (at leaſt if they reſemble you) are far better qualifi'd, to cultivate this Medicinal Subject, than I, who being as little deſirous, as fit, to

incroach

incroach upon their Province, ſhall not inlarge upon this third member of our Hiſtory, but willingly reſign it into *their*, and eſpecially into *your own*, more skilful hands.

The Concluſion.

AND now, Sir, it may be ſeaſonable to put an end, at leaſt for the preſent, to this Rhapſody of Papers, by telling you, That the foregoing *Idea* or Platform of a Hiſtory of Mineral VVaters, being a draught of, or a Firſt eſſay upon, ſo difficult and and uncultivated a Subject, as I have ventur'd to treat of; *as* I know you are too Iudicious to expect any thing of exactneſs and compleatneſs, in what I now preſent you, *ſo* I hope you will be ſo equitable, or ſo favourable, a Reader, as to forgive thoſe omiſſions and other imperfections, that I cannot doubt, but you, (and even I my ſelf upon a review,) ſhall diſcover in the *firſt edition* of the foregoing Papers. And *thô*, if hereafter they

ſhall

ſhall be thought worthy of a *Second*, I may poſſibly be able, if God be pleas'd to grant me health and Leiſure, to rectify *ſome* overſights, and ſupply *ſome* omiſſions ; *yet*, to deal freely with you, I much fear, that it will be very difficult for far skilfuller Pens than mine to deliver ſuch Hiſtories of Mineral VVaters, as the curious would wiſh, and thoſe Criticks, that have never made Tryal of the difficulty of attempts of this nature, will be forward to *require*. And this difficulty will, I preſume, be found a great one, not only, (as I have already noted,) by him that ſhall undertake to give a good account of Mineral VVaters *à priori*, but to him alſo that ſhall take in all the help he can obtain *à poſteriori*. For there are ſo many circumſtances, of ſeaſons, VVeather, place, and a multitude of contingencies, that may vary the *Phænomena* and effects of Mineral VVaters, that 'tis extreamly difficult, *either* to comprize ſo many different things at once, and as it were ſurvey them at one view, or without

without having such a comprehension and multitude of various regards, to be able to pronounce with certainty about the nature, the Medicinal Operations, and the other effects, of a Subject that may be influenc'd and diversify'd by so many causes and accidents, as a Mineral VVater may. And therefore, till further disquisitions and Tryals shall have better clear'd up the Subject, I shall, without pretending to more, think the past discourse not altogether useless, if it can well perform the office of the *virgula divinatoria*; which, (supposing the truth of what many Chymists and Metallists deliver,) of how little value soever it be of it self, is fit to point at Mineral treasures, and show men the places where they are to seek for them. *Farewel.*

'TIs known, that the drinking of Ferruginous Waters, such as those of the *German-Spaw* and our *Tunbridge*, is usually prescrib'd for many Weeks, during which time it often enough happens, that the Fall of Rains makes men doubt whether the Mineral Water be not so much diluted, as to be spoil'd in its Medicinal Capacity. And indeed I have more than once observ'd, that some such Martial Waters, after considerable Rains lost their Power of producing the wonted Colour with Galls. And therefore it may in some cases be of good use, to be assisted to Conjecture, whether or no the Rain have made the Mineral Water unfit for Drinking. In order to this I shall take notice, that usually a small Rain does little or no harm to the Medicinal Spring. And sometimes even a moderate Rain, especially after a long Drought, may, instead of weakning it, increase its vertue, by washing down into its Channel some Salts, that during the dry weather, were concreted in the Pores of the Ground, and perhaps also by heightning the Water in the Channel, so as to dis-

ſolve ſome Salts concreted there, which it could not reach before. But if the Rain have long continu'd, the Eſtimate may beſt be made, partly by the greater or leſſer depth of the Spring beneath the ſurface of the Ground, and partly and indeed chiefly, by the peculiar nature or ſtrength of the Mineral Water. For ſome Springs are much more copiouſly impregnated than others, and therefore will bear a greater dilution by Rain-Water, of which I ſhall give you this notable Inſtance. That, whereas I found (as I lately noted) that more than one of our *Engliſh* Martial Springs, eſpecially thoſe near *London*, were too much weakned by the Water that Rained into them; I had the Curioſity to try, how much of that kind of Liquor, ſome *German-Spaw-Water*, that came to me to *London* very well conditioned, would bear. In purſuit of which deſign I warily made ſome Tryals, which ſhowed, (what probably will be thought ſtrange, that when the Mineral Water was diluted with no leſs than thrice its Weight of Rain-Water, it yet retained ſtrength enough to produce with newly powdered Galls, a Purpliſh colour.

FINIS.

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